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ABSTRACT

Distance education offers a set of techniques through which new content can be rapidly and effectively introduced into schools. Its growing importance is due to these key factors: educational expansion, democratization of education, improving quality, and reducing costs. If distance teaching methods are to be used successfully for curriculum innovation within schools, there are at least four essential criteria for success: suitable materials, teacher orientation, access to school resources, and acceptable curriculum innovations. Three major roles for distance learning methods are to diversify the curriculum by introducing new subjects; to improve choice, by making a wider range of subjects available; and to change the content and emphasis of the curriculum by teaching traditional subjects with a more practical slant. Some examples of how distance teaching has been used for vocational or technical education at various levels are nonformal technical education in Pakistan, further education in Britain, the Open Tech program for technical education, and development of professional scientific and technical manpower in eastern Europe, the Soviet Union, Thailand, and India. (YLB)

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DISTANCE TEACHING: A CATALYST FOR CURRICULUM CHANGE
for introducing vocational subjects

Janet Jenkins, Solomon Inquai, Tony Dodds & David Warr

International Extension College

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DISTANCE TEACHING: A CATALYST FOR CURRICULUM CHANGE
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A paper prepared by the
International Extension College

Janet Jenkins
Solomon Inquai
Tony Dodds
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April 1986

Distance Teaching : a catalyst for curriculum change for introducing vocational subjects

This paper makes a case for distance education as an increasingly important component of formal school systems. We place a particular focus on curriculum change and the introduction or expansion of the teaching of vocational and technical subjects, but our message is broader: distance teaching is coming of age and need no longer remain on the periphery; in particular it offers a set of techniques through which new content can be rapidly and effectively introduced.

We do not attempt to discuss the extent to which vocational subjects should be introduced into schools, nor do we discuss what should be taught although we assume that vocational subjects will often have a substantial practical component. We discuss rather how distance teaching can be used to introduce new subjects into the curriculum, and how it can help with teaching old subjects in a new way. We have tried to show how distance teaching can make a major contribution, even when the subjects concerned appear unsuitable for distance methods. Many of our examples are drawn from out-of-school education, where distance teaching is more common; we attempt to show how this experience can be used in schools.

1. The changing concept of distance education

Many of us think of distance education as correspondence courses or postal tuition, no more no less. But the concept and practice of distance teaching has been changing over the years. One factor of special importance is the communications revolution. Thanks to this, we can reach everybody's living room, and talk to people at home on any subject. We can cross oceans and talk at the same time to people in countries as far apart as China, Egypt and the United States of America, through satellites. Think how much the average person today knows about Halley's comet. How is such information communicated?

The media which spread information are the media of distance teaching. Today, the distance educator may have access to a variety of media unknown to our forefathers, and designs programmes rather different from the plain correspondence courses started by Isaac Pitman and others in the nineteenth century. But the correspondence course still flourishes, and is as much part of distance teaching as Computer Aided Learning or satellite broadcasts.

Distance education today is in fact education where all or most of the teaching and learning takes place with physical and temporal separation between teachers and learners. It uses media such as print, broadcasts, cassettes or computers and can include face-to-face components, combining a selection of elements into a suitable pattern, given the resources available, the subject to be taught and the needs of the learners. Sometimes unusual media are used, sometimes a simple correspondence course is enough.

For vocational subjects with a practical component, correspondence alone is generally unsuitable. Practical skills usually need to be demonstrated to the students and video or face-to-face presentations could thus be required. We then need to assess whether learners have acquired the skills, and for this observation of performance may be necessary. Some contact between teacher and learner is an accepted part of modern distance education. The method is flexible.

2. The growing importance of distance education

The attraction of distance teaching lies partly in its flexibility. But this alone does not account for its growth. Let us briefly consider some of the key factors.

(a) Educational expansion

Distance methods are often seen as a tool to assist at times of rapid expansion of education at all levels. Examples range from Ohio University which introduced tele-lectures in viewing rooms for its 10,000 freshmen in the 1960s to radio campaigns in Tanzania which in the early 1970s reached up to two million adults in study groups. In schools, the sixties and early seventies saw large television-based projects teach children in Latin America, Samoa and the Ivory Coast, and the establishment of supervised correspondence study groups for thousands of young primary school leavers in Zambia and Malawi.

(b) Democratisation of education

The idea that everyone should be encouraged to pursue their education to the highest level possible not only requires the expansion of educational opportunities both inside and outside the formal system; it also requires these opportunities to be accessible. Distance teaching is accessible to those with little time and many commitments. From Soviet citizens in the 1920s to farmers in the Ivory Coast, from car mechanics in Venezuela to housewives in Britain, distance teaching has offered them access to education and training.

(c) Improving quality

Distance teaching can provide good teaching: the best teachers can write or speak to thousands. It can introduce new subjects or new approaches rapidly into an educational system. And it can train existing teachers to present new material.

(d) Reducing costs

Distance-teaching programmes can be inexpensive. When student numbers are high, costs per student may be considerably less using distance methods than they are for class teaching. When the methods are used for practical subjects, the cost is unlikely to be very low as equipment will be needed and the costly face-to-face element will be important. A carefully planned project on a large enough scale should, however, be as cheap or cheaper than conventional methods, and could also involve considerable savings where teachers receive orientation on the job, rather than having to leave their posts for training.

These four concerns have led to more frequent and more creative use of distance teaching, particularly over the last two decades. Uses of distance teaching in school, however, have been rather limited compared with the broader picture of university-level and non-formal out-of-school programmes. Some school projects have been among the least successful: many of the big, expensive school television projects foundered, often through a combination of high cost, technical problems and teacher resistance. Others have been small-scale and of limited impact. Despite successful experience in Australia, New Zealand and Canada of half a century of teaching rural

children at home by radio and correspondence, doubts remain about how suitable distance teaching is for young people. And further doubts persist about the suitability of the method for scientific and technical subjects, again ignoring vast experience from a few countries such as Australia and the Soviet Union.

We will now, therefore, turn to a consideration of how distance teaching can be used to introduce vocational subjects in school, and try to create a picture which dispels these doubts.

3. Implementing curriculum change

If distance-teaching methods are to be used successfully for curriculum innovation within schools, there are at least four essential criteria for success. First, we need suitable materials to teach the students. These will normally be produced centrally, by the curriculum developers. Such materials may be printed or broadcast; in either case, some months or even years will be needed to produce materials of sufficient quality, but once they are ready, they can reach all schools simultaneously.

Second, the teachers will need orientation. This might include some orientation to the subject matter, but essentially it concerns training in using the teaching materials. Teachers have to take on the new role of mentor or supervisor, and this does not come easily to those used to conventional classroom management. Such orientation could be provided at a distance but there are arguments, as we shall see below, for providing at least part of it face-to-face.

Third, a distance-teaching scheme will need access to resources in the school. The teaching of a practical subject like typing may be conveyed by the media of print or audio-tape, but the students will need typewriters to practise on. Similarly, equipment is necessary to give students access to the media of instruction: a video cassette is useless without a playback machine.

Fourth, curriculum innovations will only last if they are acceptable to both teachers and learners. The question of acceptability is a particular problem with distance education, as the promoters of change are usually far removed from the schools, and the new ideas are all too easily seen as impositions from outside. One way to reduce this risk is to provide part of the teacher orientation discussed above face-to-face rather than at a distance.

Let us now consider some examples of distance teaching for vocational subjects, focussing our analysis on these questions of implementation. We will look first at experiences in schools, and then introduce a few examples of out-of-school education to elaborate the picture.

Vocational subjects within schools

There are three major roles for distance-learning methods: to diversify the curriculum by introducing new subjects for all children; to improve choice, by making a wider range of subjects available to children, some of them optional; and to change the content and emphasis of the curriculum, by teaching traditional subjects with a more practical slant. Distance teaching allows such changes to take place more quickly and cheaply than by conventional means, and demands less highly skilled manpower to introduce them.

(a) Diversifying the curriculum

In 1971 the Mauritius College of the Air (MCA) was established. A major part of its early work was concerned with using distance methods to improve secondary education. This included the introduction of vocational subjects in school. Tony Dodds describes what happened:

> From as early as the 1890's when the Ward Report was produced on education in Mauritius, through to the present day, criticisms of the Mauritian system have been levelled at its over-academic concentration and its lack of practical, technical and vocational preparation. Proposals have been made and experiments tried to change this emphasis. As Ramdoyal has pointed out, few of these have brought about fundamental changes. As was stated in the first MCA course proposals and in the first year's progress report, these past problems had to be seen as warnings but not as an unsurmountable barrier: the attempt had to be made again if Mauritius' development strategy were to stand the remotest chance of success. The standard reasons quoted for the failures of the introduction of technical and vocational courses are the prevalent attitudes amongst students and their parents and teachers against practical and manual activities in favour of clerical and white-collar professions, against education which involves getting one's hands dirty in favour of bookish learning. We believed that the prejudices which give rise to these attitudes are actually more rational and therefore more amenable to rational change than is generally believed. Agriculture in the popular understanding means cutting sugar cane, an extraordinarily unpleasant activity. A mechanic, at least for the first several years of his working life, is an underpaid, exploited apprentice in a backstreet garage or carpenter's workshop. The good life which everyone hopes for - and if he cannot achieve it himself he wants it for his children - has no connection with such activities. The way out of exploitation and hardship and into respectability and comfort is education. Therefore in the popular view education cannot be about agriculture and mechanical skills. The prejudice is not against the activities themselves but against the conditions of exploitation that go with them. Only when these conditions no longer obtain - and in Mauritius today they no longer obtain universally - and when they can be clearly shown to be a thing of the past, will the prejudices be broken.
>
> MCA's purpose therefore in introducing such pre-vocational courses is not necessarily to prepare students to become farmers or carpenters and joiners, though the courses contain essential knowledge and skills for farming and for carpentry. Their objectives are threefold: to introduce students to technical knowledge and to skills which will provide a more useful preparation for scientific, mechanical and technical careers at any level than will a knowledge of foreign literature, or British constitution, or Latin, or religious knowledge (important as some such subjects may be as supplementary parts of a complete education); to indicate to students that such subjects are of at least equal educational importance and status and require as much high-level scientific and intellectual ability as any others; and to illustrate, through stimulating practical experience, that working simultaneously with brains and hands, even getting the latter dirty, can be enjoyable, intellectually exciting and rewarding.

> The first decision was that the courses should be introduced at form 1 level. In this way the students would be as far removed as possible from the dreaded examinations. The syllabus could therefore be flexible and experimental. Decisions as to whether these subjects would eventually be continued up to form V and School Certificate or whether the majority of students could be expected to end their courses with some intermediate and locally meaningful certificate after form III, could be delayed until reactions and feasibility were studied. Secondly, only a very limited number of schools and students would be admitted, so that the impact of the many mistakes which would inevitably be made and of the problems which would emerge but which could not be foretold, could be immediately corrected and minimised. In the event, as will be described, this decision was entirely justified. And thirdly, the essence of the courses must be a careful and continuous blending of classroom learning and practical, related experience, so that schools would have to have some practical facilities, in the form of school farms or workshops.
>
> It was foreseen that the main difficulty would be to find a satisfactory blend of practice and theory and to enable the teaching of essentially practical subjects through printed correspondence pamphlets and through television programmes. MCA stipulated that schools devote at least two periods a week to either subject, one practical and one theory, and that the latter be built around the television programmes. The correspondence pamphlets describe, in simple detail, the practical exercises which form the core of the courses, and from which the theory is derived; they are well illustrated with simple, step-by-step diagrams. The practical exercises are supported by some form of 'extension' visiting service from MCA to try to ensure that the school farms and workshops do not make disastrous and irreparable mistakes. Many of the classroom teachers, as was also foreseen, have had very little or no experience of these subjects before.
>
> (Dodds, 1975 pp.25-26)

At first, there were many problems: difficulties in obtaining and distributing tools and materials, misjudgements on time required for activities and so on. But the initial response from teachers and students was enthusiastic. The courses did not continue to be run by the MCA for many years but were soon taken over, developed and expanded by the new Mauritius Institute of Education. There are however several important lessons to be learned from this experience: first the importance of involving the teachers closely in the development of the system, and the need for regular orientation programmes and consultation sessions with them as it progresses; secondly the need for self-explanatory materials to introduce and guide both teachers and students through the practical activities; thirdly the possibility of providing practical kits for class use to enable the practical activities to take place; and finally the importance of supervision through visits to the schools by staff of the distance teaching institution to boost the morale of the teachers who are expected to introduce the new subjects.

(b) Improving subject choice

The range of subjects offered by a school need not be restricted according to the number of specialist teachers available to teach them. Distance teaching can be used to complement face-to-face teaching and extend the range of

subjects available. It is widely used for this purpose in British schools. It is interesting to consider how and why this happens, in a country without any serious teacher shortage.

Distance-teaching materials are used mainly for secondary subjects at examination level. A common arrangement is for an individual or small group of children to follow a correspondence course in periods specified in the school timetable. A teacher is on call to assist when necessary, and work is marked by a specialist teacher on a part-time basis, possibly by correspondence.

There are two situations where this system is quite often used. One is when a child has failed an exam and needs to retake it; the other is when small numbers of children wish to study a subject of minority interest. More rarely, a normal-sized class may follow a mainstream subject by correspondence. This can occur if, for example, the subject specialist leaves suddetly and cannot be replaced at once.

In Britain, these arrangements, though quite widespread, are for small numbers and are often temporary. Problems that could arise with untrained supervisors or student resistance are partly contained, since such schemes are only likely to be introduced where a member of staff is personally enthusiastic. For our purposes, their interest lies in their potential. The use of distance-teaching methods in school can release teaching capacity, create an opportunity to introduce more subjects, and make the timetable more flexible.

An attractive possibility at first sight is to use distance-teaching materials for the humanities, more obviously suitable to the method of study, and release teachers to concentrate more on scientific and vocational subjects, thus diversifying the curriculum. Practical subjects are more difficult to teach at a distance, and it is in these that teacher shortages usually occur.

In fact, science provides us with an example of a long-running and effective use of distance teaching in schools in Britain. Around ten years ago, the Inner London Education Authority (ILEA) set up the Advanced Physics Project for Independent Learning (APPIL). In many London comprehensive schools, the number of students opting for science 'A' levels was quite small. APPIL was to provide learning materials so that students in both the first and second year of their 'A' level studies could be grouped together, under the supervision of a single teacher. For about half of the time they would work independently, and half the time with the teacher. APPIL provided self-instructional modules for each topic in the syllabus, and a variety of audio-visual support materials.

The scheme has endured and developed over the years. The materials are currently being revised, and similar chemistry and biology courses have been developed. APPIL materials are extensively used in London, usually by schools with small sixth forms, but also by some schools who like this way of working. Some schools outside London and a few institutions in Africa and elsewhere also use APPIL.

The materials are of high quality, and this partly accounts for the success. But according to John Bausor of ILEA who has been involved from the early days, a major factor is that the teacher retains an important role. APPIL has always considered it important to train the teachers to use the

materials, giving them an opportunity to meet each other and exchange experience. Recently, it has been difficult to arrange such meetings, and the scheme has had less success in some schools where teachers were not well prepared and had not fully realised its teaching implications.

We have here a useful model for the use of distance teaching in schools, and some guidelines for successful implementation. We can see that we may be able to combine distance teaching for some subjects and conventional teaching for others - more attractive than teaching all subjects at a distance. Nevertheless, in Malawi and Zambia the National Correspondence Colleges provide thousands of young people with secondary schooling in supervised study centres. Here students follow correspondence and radio courses in a range of subjects, with the guidance of supervisors. Tuition is provided by correspondence. These Centres are moderately successful, but little attempt has been made to introduce science subjects, and there is no curriculum innovation. If such changes were to occur, supervisors would have to take on a different, more active role.

(c) Changing the curriculum

The Ministry of Education, Zimbabwe, has chosen to follow an unusual and interesting path for curriculum change. A new curriculum has been adopted, with technical subjects such as carpentry, metalwork and building compulsory at secondary level. The Ministry through its Curriculum Development Unit has decided to use distance teaching as a means to implement the curriculum and introduce the new subjects.

The Zimsci project led the way. This scheme was started some years ago, and now provides print and audio materials and an experiment kit to cover the entire secondary curriculum up to 'O' level. The syllabus is divided into units, and for each there is a pupil's book and a teacher's guide. The materials allow the children to learn without a specialist science teacher.

The Zimsci team now forms part of the Curriculum Development Unit, where teams produce materials for all subjects at secondary level. These normally consist of pupils' materials and teachers' guides. Each team runs seminars to introduce new materials to the teachers.

This dramatic switch of emphasis from teacher orientation to teaching children directly through printed materials was necessary because of the magnitude of change: new subject content, a huge expansion of lower secondary school places, new attitudes to learning and new subjects were all introduced at once. Only distance teaching could meet the requirement of speed. But Zimbabwe sees distance teaching as much more than a catalyst at a time of crisis. One aim of the new curriculum is that young people should develop skills of independent learning, which will help them contribute to their nation's future development. It is therefore expected that distance teaching will be an enduring component of secondary education.

(d) Teacher education

There are now many developing countries that have used distance teaching for teacher training, ranging from large schemes in Pakistan, Tanzania and Zimbabwe to small ones in Malawi, Swaziland and Lesotho. Distance teaching is used to train or upgrade teachers while they continue to teach in their schools. Teachers normally receive correspondence materials and in many cases also listen to radio programmes or even watch television. There is

normally also a face-to-face element, ranging from substantial residential sessions to occasional seminars. Each such scheme is designed according to the intended scale of operation, and the needs and resources of the country concerned. This mode of in-service training is an economical and rapid way to introduce new subjects into the curriculum.

All these examples suggest models for introducing vocational elements into schools. But the experience is often recent, often rather general. It will therefore be useful to complete the picture by looking briefly at some examples from non-formal, further and higher education.

4. Some out-of-school examples

In this section we will look at how distance-teaching has been used for vocational or technical education at various levels. Of course, the first correspondence courses in the nineteenth century were concerned with vocational subjects, such as book-keeping or shorthand. They were produced, moreover to enable students who moved away from urban schools where such subjects were available, to rural schools, or out of school altogether, where there were no teachers to teach them. Our interest here is in the more practical and technical subjects, which are more difficult to introduce into schools which do not have trained teachers or adequate equipment, and which have also presented a greater challenge to distance educators dealing with out-of-school students. Our examples will illustrate some ways in which such education has been successfully organised in further education institutions and even among illiterate farmers in the Punjab in Pakistan. We will suggest that such methods, if feasible there, could also be used in schools.

(a) Non-formal education

An unusual example of non-formal technical education comes from Pakistan. The Allama Iqbal Open University (AIOU) there recently ran as a pilot, with the assistance of the International Extension College, a Functional Education Project for Rural Areas (FEPRA). As part of its work FEPRA taught subjects like child care, poultry keeping or 'electricity in the village' to groups of villagers, the majority of whom were illiterate. David Warr describes the project as follows:

> FEPRA's main task was to develop and test a distance-teaching methodology which could be used on a large scale to reach rural adults effectively and cheaply. The resulting methodology, which now forms the basis of AIOU's long-term programme of basic functional education is outlined as follows.
>
> Group, rather than individual, learning is used. This provides support for those who have had little or no formal education; it encourages discussion, the sharing of experiences and group decision-making; and it lowers the cost of producing and distributing the learning materials. Groups of approximately 20 adults meet and study about twice a week, at a place and time of their choosing. The meetings are monitored by locally recruited assistant supervisors who work under a small team of field supervisors. The courses are specially timed to take place outside the busiest periods of agricultural activity.
>
> One person, who is appointed by the other learners, acts as a group leader, and is responsible for arranging meetings, presenting

learning materials, leading discussions and providing feedback. Group leaders, who are usually, but not always, literate, receive six days of training for these tasks. It is stressed that they should not act as teachers or subject matter specialists. Training is conducted by mobile teams at temporary field centres which are easily accessible to clusters of participating villages.

Simple media are used to carry the teaching messages. They were selected to suit a mainly illiterate target group, to be cheap and easy to produce, to be robust and simple to handle in the field, and to be independent of mains electricity. The materials used at each meeting include an audio cassette, a flip-chart, a set of take-away pictorial handout sheets and guide notes for the group leader. Charts, picture cards, models and other materials are also used where appropriate.

These course materials are produced at the university campus. They are carefully structured both to carry new ideas and information, and to guide group learning activities. Messages are presented on the tape through drama, interviews and narration, and are complemented and reinforced by the flip-chart illustrations. Instructions to group leaders (e.g. about when to turn to the next illustration, or when to stop the tape for discussion) are recorded on the tape at the appropriate times.

Great importance is attached to group discussion. The learners are asked to reflect critically on what they have heard, to relate it to their own experiences and village circumstances, and to make group decisions about how to apply what they have learned. Discussions and practical exercises are also introduced as a means of ensuring the group members' active participation in the learning process.

This form of education for rural development requires that the university works as closely as possible with other development agencies already working in the field. Thus a course on agricultural credit was produced and is being presented in close collaboration with the Agricultural Development Bank of Pakistan, a livestock management course with the Provincial Livestock Department, a course about electricity in the village with the Water and Power Development Authority. Collaboration takes places at national, provincial and local levels, and covers all stages in the planning, production and presentation of the courses.

Action research plays a vital part in course production. In the FEPRA model, this is carried out by a small team of university field workers based at a rural centre in each of the cultural areas to be served by AIOU. Initial background studies provide information about the needs, capabilities and limitations of rural adults in the area concerned. This helps the university to decide what new courses will interest and benefit potential learners.

During the production stage, draft versions of course materials can be pre-tested with potential learners in the field, and modifications made where necessary. Once a course has been completed, it can be put through a pilot cycle, evaluated and again modified if necessary before being reproduced in final form.

> To carry the completed courses to large numbers of learners as economically as possible, FEPRA envisaged the use of small mobile teams. These would set up learning groups, train group leaders, distribute the course materials, monitor each course cycle and feed back the information to the course producers at campus. In addition, they could train and assist local representatives of development agencies to present AIOU courses through their own field networks, thus greatly increasing the coverage of the university's programme.
>
> FEPRA was able to demonstrate, over three cycles of courses, that this methodology can work well. Rural adults were keen to participate; drop-out rates were low; there was a significant, measurable learning effect; and there were encouraging signs that people were applying some of what they had learned on the courses.
>
> (Warr, 1985 pp.6-8)

Group study is an ideal way to learn for those with little formal education. Members of a group quickly learn to work together and help each other to solve problems or master techniques. As our example from Pakistan shows, distance teaching makes it possible for such groups, without teachers, to learn practical and technical skills. For those in urban areas, such group study can readily be organised at the workplace: examples range from groups of Algerian factory workers in the 1960s studying basic mathematics in groups, to the new Open Learning Centre at the Jaguar car plant in Coventry, where an employee can choose anything from a Masters' to a beginners' course, in a wide range of subjects.

The growth of Open Learning is important for distance teaching at all levels. The two are not identical, but overlap considerably. A key characteristic of open learning is its accessibility. An open-learning centre offers resources for learning, whether these are materials or teachers. The mode of study may be individual, group or class, face-to-face or distance-based. It attempts to be flexible, to meet the needs of individual students. Thus, the distance mode of study is on an equal footing with other modes, and students may switch from one to another as their studies progress. The Open Learning Centre and its co-ordinators or supervisors provide guidance on study programmes to individuals and perhaps organise self-help groups, rather than teaching the students.

In non-formal education we therefore find examples of distance methods introducing vocational subjects to people with little or no formal schooling, and we find an emphasis on group study and self-help. Would it be useful and possible to adapt these approaches in schools? The example of Further Education in Britain suggests that it would be.

(b) Further education

In Britain, many of those who leave school at 16 continue with full- or part-time classes in academic or vocational subjects at further education or technical colleges. These young people are concerned to get employment in the long-term, and seek qualifications to help them. They include those who have been less successful academically at school.

In recent years further education colleges have attracted growing numbers of such students, at the same time as the number of examination schemes has increased. Some colleges, instead of offering more classes, have opened

workshops for high demand subjects such as maths and English. A workshop is a substantial space furnished with desks and tables, often with some screens or partitions to provide an element of seclusion. Learning resources are readily available. These may include shelves of reference or text books; duplicated self-study lessons on various topics; workcards for activities or projects; assignment sheets for work for marking. Sometimes audio or video materials are also available; computing facilities are still rare in workshops, though normally available elsewhere in the college. Workshop co-ordinators work out with each student or group a study pathway, deciding which of those materials to use and in which order. They are then always available in the workshop, and are ready to assist individuals or groups as necessary.

The students are therefore basically working on their own, and the majority like it (Jenkins, forthcoming). They prefer it to school, and the realisation that they can manage their learning themselves seems to build up their confidence. They appreciate the opportunity to study at their own pace, and they shift naturally between individual study and pair and group work in the supportive environment of the workshop.

These findings suggest that a shift from class to workshop could be desirable more often, particularly in schools. Evidence that young people, even those with little academic aptitude, respond well to independent study is rare; here we find the workshop stimulates the enthusiasm of such people.

Vocational subjects are a strong candidate: a vocational skills workshop could excite the students and offer a wide variety of study options but require limited teaching resources. The organisation of such a workshop will require careful planning and management. Two keys to success will be the teachers involved, who must support the project and will need some training, and the resource materials available. Some will be college-made, some will be developed elsewhere, and these will include distance-teaching materials. They must all be high quality. The development and selection of such materials is an area which has particularly interested Britain's latest large open learning venture, the Open Tech.

(c) Technical education: the Open Tech

The Open Tech programme aims to enable employed adults to prepare for or adapt to changes in work through a variety of training programmes. It has British government funding for four years, until 1987, after which individual programmes must be self-supporting. Over 100 projects are now operating, organised by a variety of institutions and using any form of teaching which gives access to learning opportunities; but with an emphasis on new technology. The stress is on job competence rather than qualifications. Such packages or at least similar packages, could help to introduce technical training into schools, and could also introduce an important link between school and work.

The Open Tech has begun to revolutionise technical training in Britain. This is not the place to describe its work in detail. It is, however, appropriate to draw attention to an important component of the Open Tech, the support projects, which provide an infrastructure of services. These include the Materials and Resources Information Service (MARIS) run by the National Extension College. David Tinsley, the director of the Open Tech Unit, describes it as follows:

> MARIS has developed a comprehensive data base of available open-learning packages and resources; not just those created as a result of the Open Tech Programme. Well over 5,000 packages are now listed including full information on where and how to obtain them. Currently, the MARIS data base can be contacted by telephone or letter but experiments are to be undertaken with access using the Prestel viewdata system and with on-line access. Using the MARIS service Open Tech projects can quickly determine the availability of existing material and thereby tailor their own development of materials so as to avoid any duplication. Open Tech projects, and anyone else wishing to meet a training need, can use MARIS to identify the materials they need and can then arrange to provide delivery to their clients.
>
> (Tinsley, 1985 pp2-5)

A similar information service could be valuable in spreading the use of distance teaching for vocational education in schools, with data available on an international or national basis.

(d) Science and technology at tertiary level

Enough has been said to make the case for distance teaching as a suitable method to complement others in introducing vocational subjects into school, and there is no need to introduce examples from tertiary-level practice. A final contribution to the discussion can however be drawn from experience at this level. This relates the importance given to distance teaching in some countries as a means of developing professional scientific and technical manpower. In Eastern Europe and the Soviet Union, for example, correspondence courses have provided a route to a degree parallel and equal to the face-to-face route for many years, in many cases for over half a century. Distance education is a normal, established part of the education system in these countries, whatever the subject of study. More recently, the newer Open Universities in developing countries, such as the Sukhomai Thammathirat Open University in Thailand and the just-founded Indira Gandhi National Open University in India have put particular emphasis on professional, vocational and technical training. At university level, therefore, we see distance teaching used for vocational education with tens of thousands of students.

While the needs and competencies of students at secondary and university levels are very different, it is still instinctive to note the differences in scale of operation at the two levels. The ventures at secondary level look timid beside the university-level projects. There appears to be no good reason for the hesitation. Students in supported self-study schemes in schools are well able to handle the demands of distance education, perhaps better than isolated adults; and in any country the use of distance teaching in schools must bring greater economies of scale than at university level.

The out-of-school examples we have considered have shown further how distance-teaching methods can combine flexibly with face-to-face education to extend access to vocational or related education. They have shown different patterns of partnership between learning, college teachers and central providers of materials, and suggested how information and exchange of materials can contribute to the development of effective schemes. Finally, a look at tertiary education suggests that the vision of educators at secondary level is usually restricted. Distance teaching contributes to secondary-level education in most countries, but usually on the periphery of or even

outside the formal system. Only a handful of countries have made it an important component of their formal system. It is time to re-examine this, and consider making it an integral element of the system in more countries, whatever their stage of development.

Conclusions: an agenda for development

Distance teaching is an acceptable method of skills training. When employers frequently demand new skills, the flexibility and adaptability of distance teaching are invaluable in introducing these new skills into the education system rapidly. It can make a direct contribution in schools, colleges or universities by providing specially designed materials in any field. These may be long courses or short modules. Distance teaching can provide for individual or group learning, perhaps in a workshop, can offer a wider choice of subjects and allow a variety of options. A question for further consideration is, therefore, in what circumstances should we introduce into our schools distance teaching for training in vocational skills?

A second issue concerns the organisation of practical work. There has been some mystification attached to practical work in technical and scientific subjects, to the extent that people started to believe that nothing was possible without an elaborate laboratory set up. Distance teaching has helped to open our eyes, not by denying the value of practical work but by showing that a great deal of it can be improvised in the home. People can do their own experiments or learn skills, provided they are able to get certain basic materials or equipment. This also applies to schools, particularly the less well-equipped schools. Distance teaching can help them to improvise and to supplement what they have. Moreover there are many resources in the community, particularly skilled artisans or practitioners, who can help learners, either by visiting schools or colleges, or by allowing individuals or groups to have some experience of work with them. We need therefore to consider how practical work can best be organised in different communities and for different subjects, and in particular in poorly equipped schools.

This leads us to think, too, about maintaining a balance between the need for individual supervision of learners and the economies that come from using centrally-produced teaching materials. It is particularly difficult to arrive at the right balance with practical subjects. A useful trend is the tendency to divide materials into short units or modules, which facilitates in turn the exchange of materials and the use of a single unit for several different purposes. We should ask ourselves in this context how we can best organise economical programmes.

We have tried, in this paper, to bring forward a variety of examples of ways in which distance teaching techniques have been used to expand or to support the provision of technical and practical training both in and out of school. We have argued that what has been done successfully at tertiary level, in further education and even in non-formal education could also be done, possibly more effectively, in schools. We have provided a few examples of distance teaching being used in schools to introduce new subjects. Distance teaching can lighten the burden of the classroom teacher and can make it possible for the teacher to provide individual attention. It can also enable teachers to introduce and supervise subjects which they are not trained to teach by themselves. In these ways we believe distance teaching can make an important contribution to the expansion of technical and vocational training in schools.

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